EXPLAINING SCIENCE

Integrating Science Literacy Into a Research-Based Undergraduate Program

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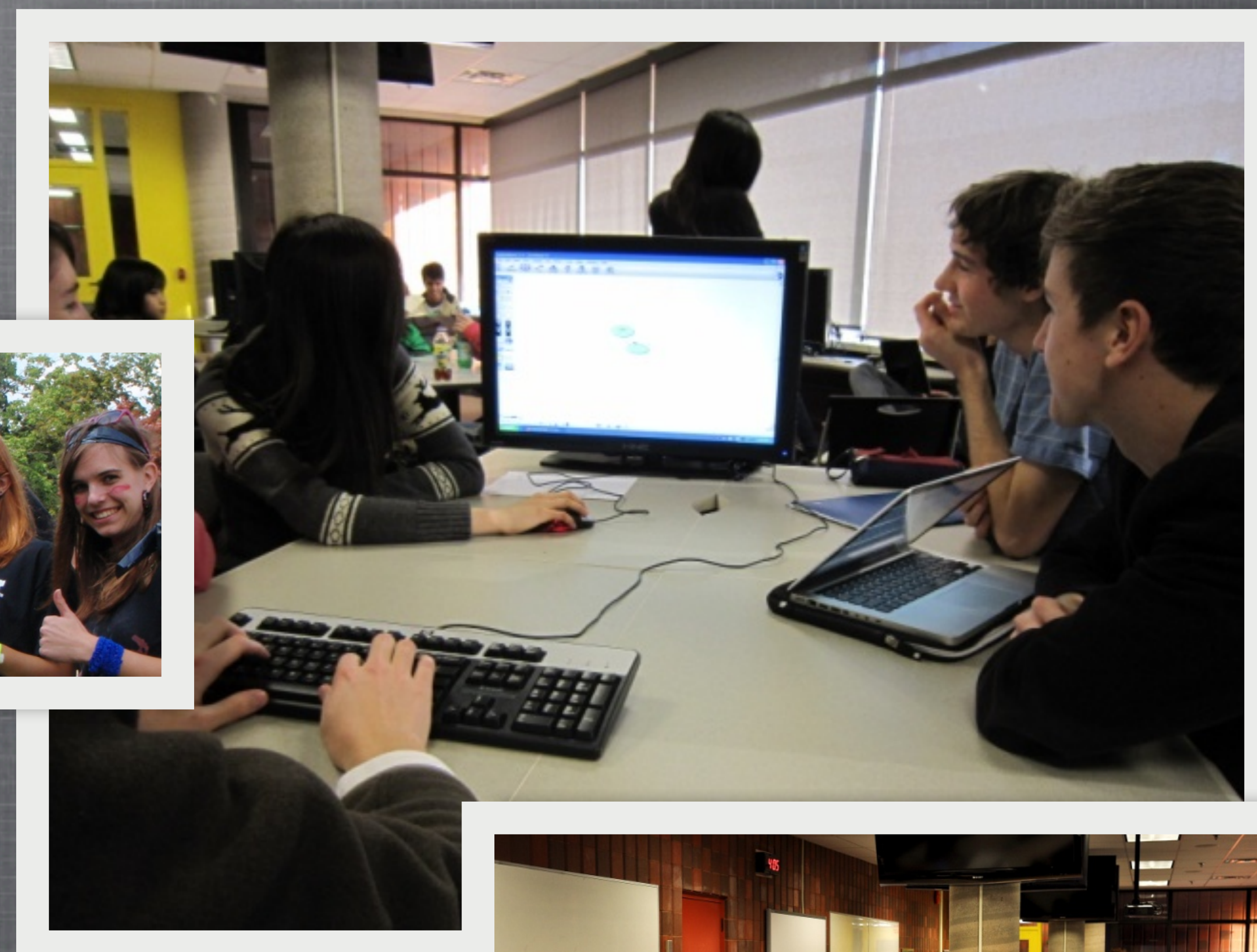

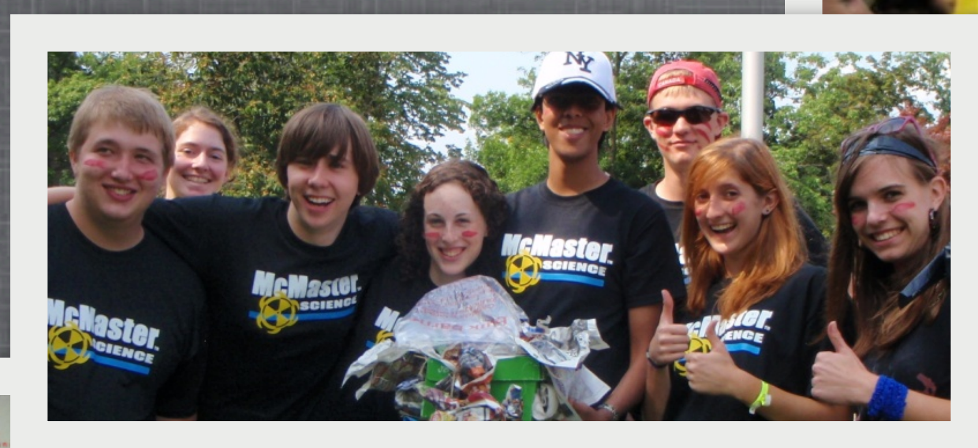

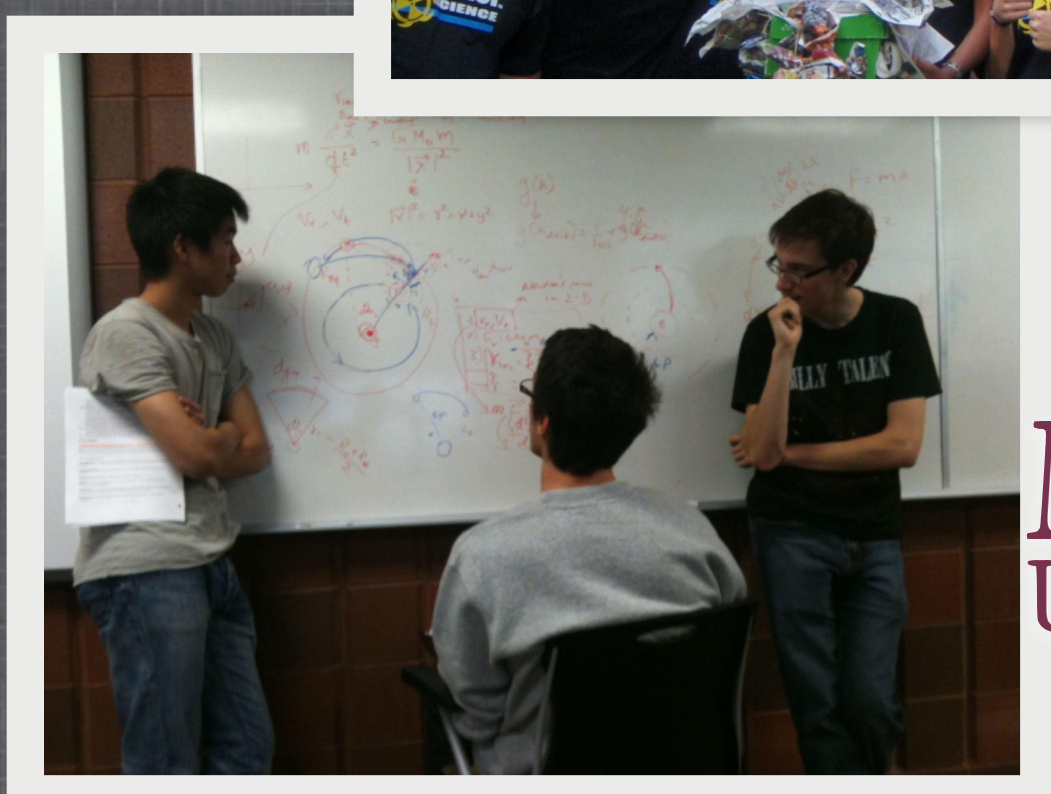

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Outline

1. About the Integrated Science program
2. The goals of Science Literacy
3. The implementation of Science Literacy

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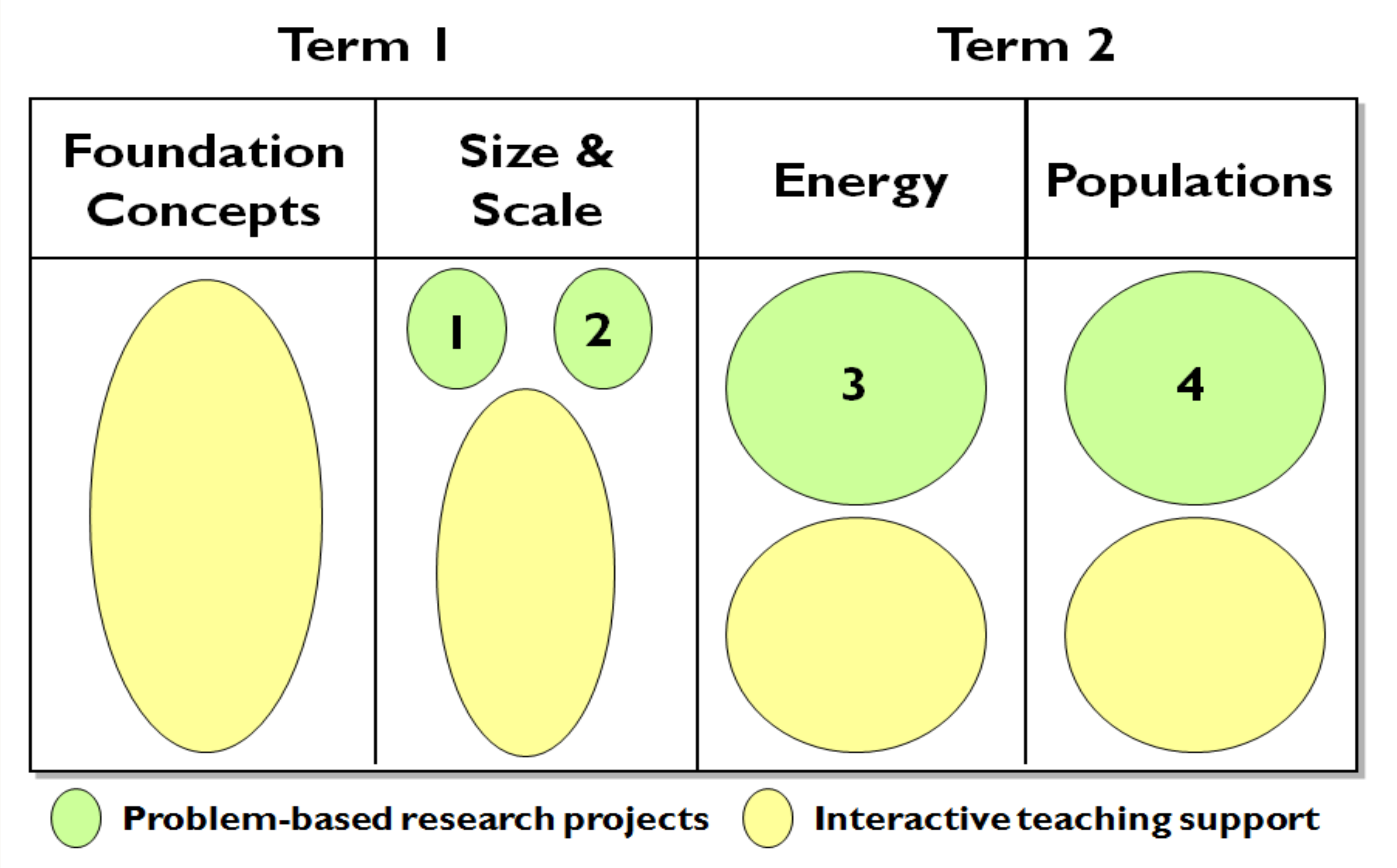
What is iSci?

- New – introduced September 2009
- Interdisciplinary, research-based science program
- Limited enrolment program targeted toward highly motivated, high achieving students
- Small class sizes (max. 60/year)
- Collaborative, self-directed learning

Research Project as Focus



Mission to Mars

- Plan a manned/unmanned mission to Mars
- Make design decisions about: rocket design, propulsion, landing site
- Determine what you will research on the planet
- Write report and present results

Role of the Library

- Home-base in library
- Librarian embedded into program
- Students heavy users of ‘found’ information early on

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Science Literacy Vision

"The iSci program will also intentionally teach "literacy" in its broadest sense. This component will be one of its most distinctive features, unlike any other science undergraduate program in Canada."

"Steps towards fostering scientific literacy will be embedded within the core components of the iSci program."

-iSci Design Document, 2007

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Science Literacy Vision

- “Developing [writing] skills... frequently...”
- “poster session”
- “...best use of research resources”
- “...assessing [information] quality”
- “...instilling... research ethics”
- “...collaboration with... library representatives”

-iSci Design Document, 2007

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Science Literacy Model

Team Taught

Weekly 2hr class
(level I)

Assessed Component
(level I-IV)

project marks attached to drafts and/or final deliverables

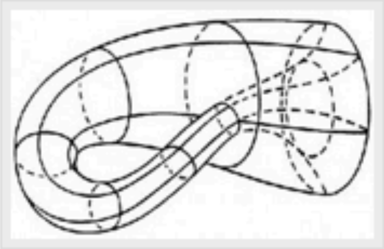
non-project marks:
blog writing, participation

Outline of programming

- Regular scientific writing (blog)
- Project deliverables: presentations, posters, reports, debate, book creation, etc.
- Classroom activities

Blogging

Another nonorientable surface is the Klein bottle. A Klein bottle (named after the German Mathematician Felix Klein, 1849-1925) is similar to a Möbius band in that it has only one side. In addition, Klein bottles have no boundary (no 'edge'); they are continuous, smooth surfaces. Klein bottles can be constructed from a rectangular sheet by attaching the long edges together without a twist (forming a cylinder) and attaching the short edge together after one half-twist (Stewart, 2010). Various Klein bottles are shown below.



…ensions, the surface of the Klein bottle must pass through itself in order to perform the half-… …pologists ignore this intersection, since it can be avoided in higher dimensions, but it is …ble to avoid when constructing a model in 3 dimensions (Stewart, 2010).

…he fact that a Klein bottle has only one 'side', there is no 'inside' and no 'outside' to the bottle. …bottle is not a solid, but a surface, and therefore the volume of any Klein bottle is zero …, 2010).

Mar 25 / Ad…

The Missing Xenon

Fluorine and xenon chemistry is a branch of science that is filled with groundbreaking an… startling discover… were once believ… be synthesized f… trioxide (XeO_3) a… xenon dioxide (X… came to an end v… first successful s…

Brock and Schro… crystalline xenon… occurred when 2… seconds, a brigh… 78°C to precipita…

Three-Way Mutualism: Ants, Fungus and Bacteria

Ants are one of the few organisms that grow their own food. Ant agriculture is thought to have originated 50 million years ago in South America when ants entered a mutualistic relationship with the many species of fungus they harvest (Shultz 2009). In this relationship, ants nurture the fungus to increase fungal growth while it in turn provides the ants with a food source. This provides an efficient method of foraging for both organisms, indicating that the association of ants with fungus is highly evolved (Dugatkin 2009).

Fungus-growing ant species, belonging to the attine family, also protect their fungus gardens against parasites by introducing a third organism to the mutualistic relationship (Shultz 2009). Ants that work in a fungus garden have a white crust on their body that was discovered to be the bacteria *Streptomyces*. *Streptomyces* produces antibiotics specifically effective against *Escovopsis*, a parasite that causes the fungus serious harm. Less dangerous parasites are not susceptible to the antibiotics. Only the ants that work in the fungus garden were observed to have the bacteria on their body. These female worker ants are also responsible for starting a new ant nest and transmitting the bacteria to the new ant population. Ants pass the bacteria down to their offspring to ensure the next generation has the bacteria to protect their food source (Dugatkin 2009).

Attine ants clean the fungus garden by collecting the *Escovopsis* spores and hyphae in the gar… and placing them in their infrabuccal pocket. The infrabuccal pocket contains the *Streptomyces*… antibiotics that kill the spores and hyphae. The ants then dispose of the dead spores and hyph… outside of the fungus garden (Dugatkin 2009).

Ants have evolved an efficient method of cultivating food through their mutualistic association w… fungus. They have also found a way of defending their food source by adding a third mutualist, *Streptomyces* bacteria, to the relationship (Dugatkin 2009). This complex mutualism illustrates… marvels of nature: long before humans even contemplated agriculture, three organisms develo… effective system of farming that has stood up to 50 million years of evolutionary testing.

References:

Dugatkin, L.A. 2009, Principles of animal behavior, 2nd ed, W.W. Norton, New York.

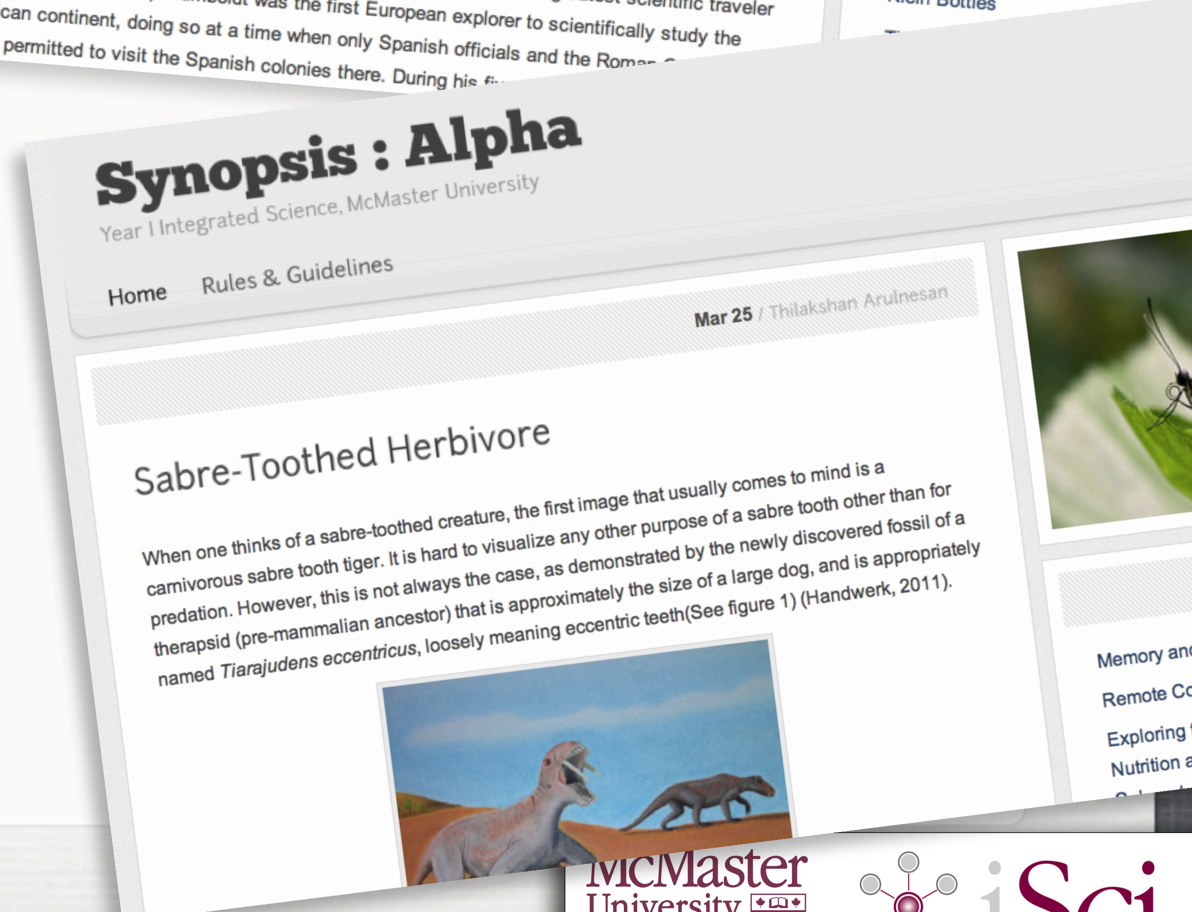
Schultz, T.R. 2008, "Major evolutionary transitions in ant agriculture", Proceedings of the National…

Force of Nothing: Casimir Force

The casimir effect describes a force generated by a quantized field and was mathe… discovered by Hendrik Casimir in 1948. It is a consequence of quantum electrodyn… that there is an attractive force between two uncharged metal plates due to zero-po… electromagnetic field. The casimir force has two components: thermal and quantum… component is related to temperature and arises from thermal fluctuations in the fiel… quantum component arises from quantum fluctuations. Although the casimir force …

Blogging

- peer-commenting required (participation)
- Feedback by TAs in comments
- One week for editing draft version
- Assessed: best three posts (students choice)



Project Deliverables

- High-stakes, collaborative project work
- Varies: Written Report + Presentation / Poster / Debate
- History of the Earth: book

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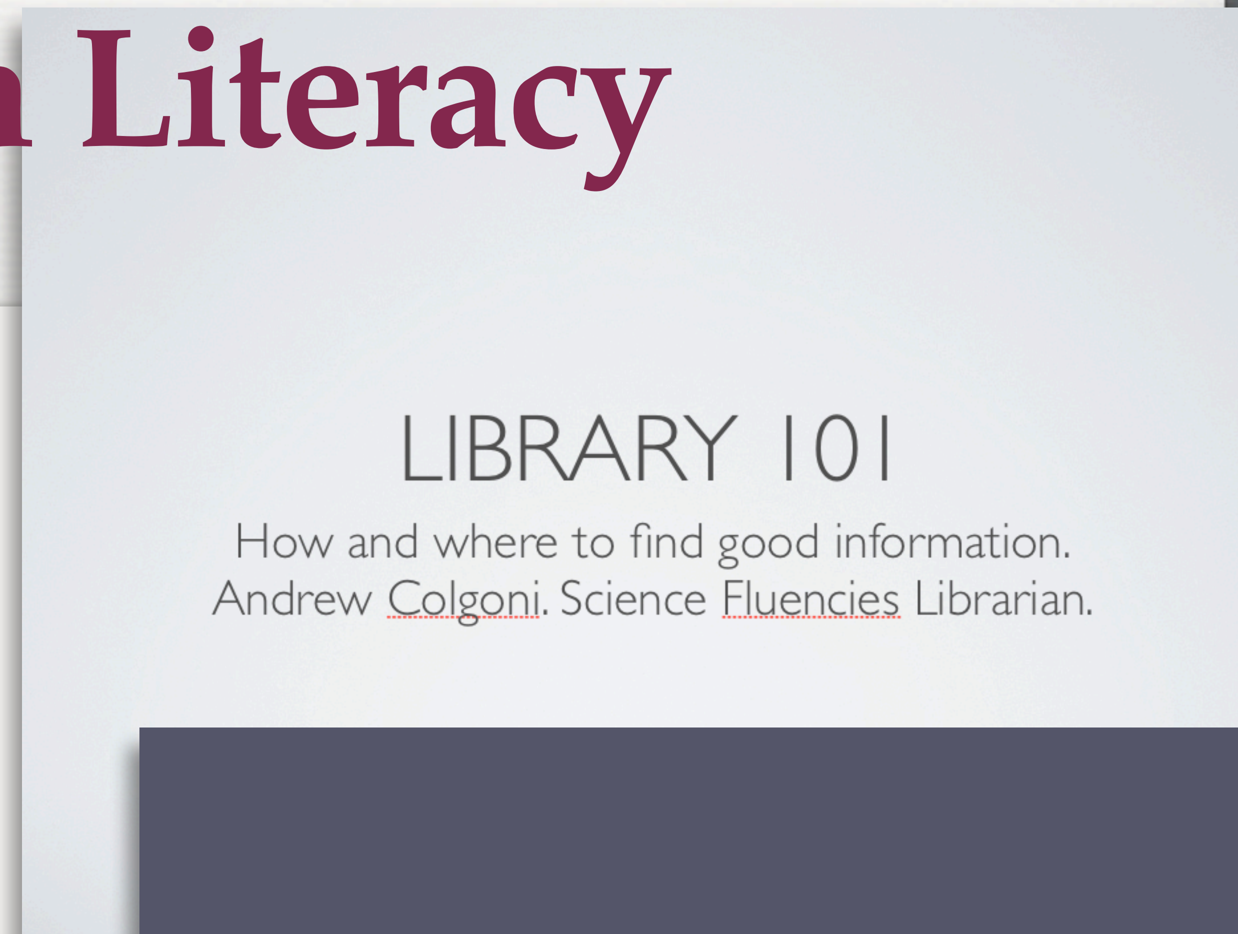
Classroom Activities

- Usually involves pairing a short lecture with a longer activity
- Often tied to deliverables
- Offer a variety of instructional methods, including: discussions, clicker quizzes, peer feedback, worksheets, lecture, etc.
- Revisit themes: communication, academic integrity, writing, information literacy

Information Literacy

- Distinguishing btw. sources, using databases, advanced searching, RefWorks, citing
- Often just-in-time
- Might be a quick lesson or a full activity, depending



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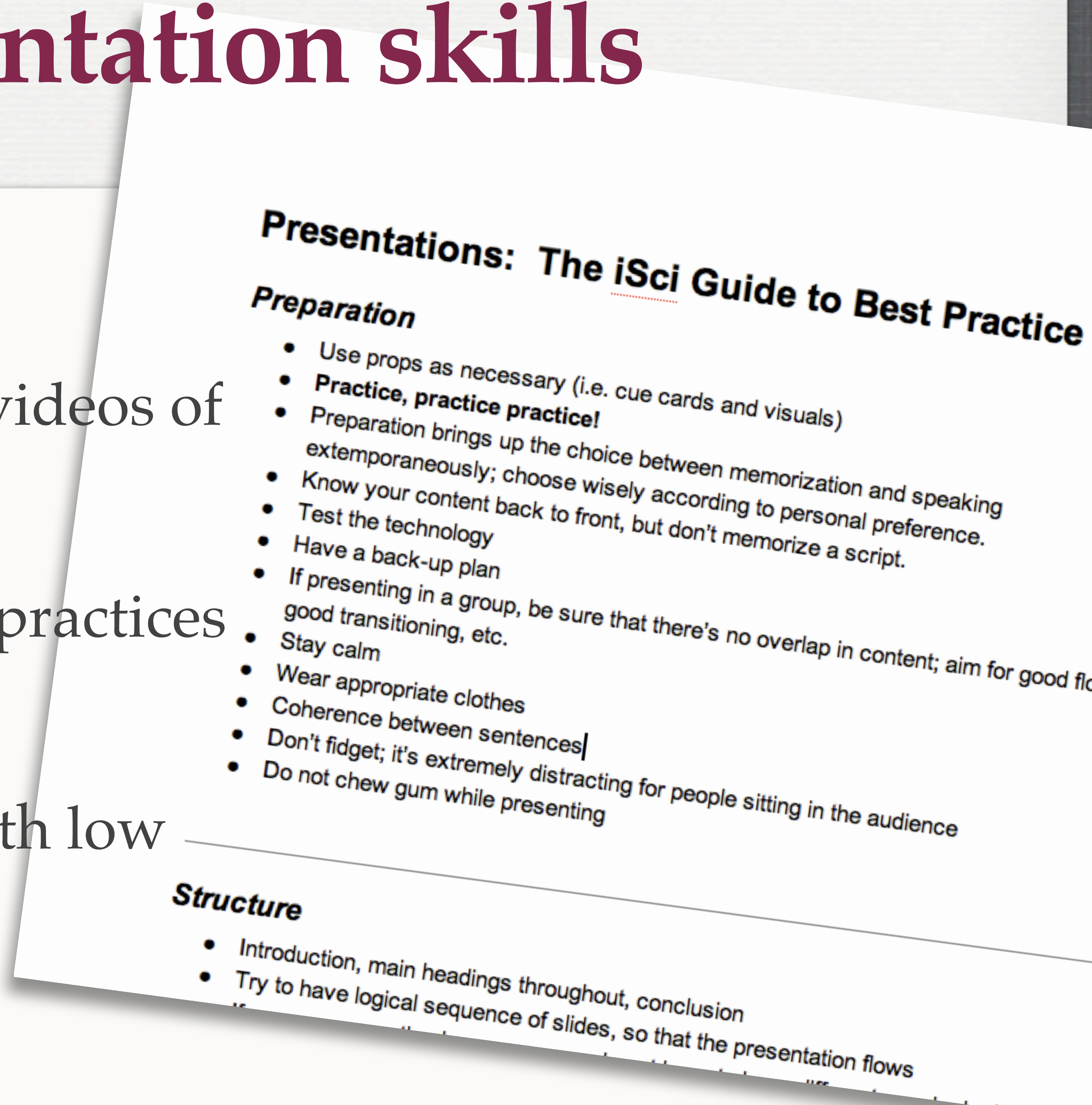
Evaluating Sources

- Students worked in small groups, each at a computer.
- Each group given a URL to a website.
- Evaluated website and then reported to the class on their verdict.
- Each website could be seen by the whole class.

Presentation skills

- Watch and critique videos of presentations
- Collaborate on best practices document
- Provide students with low stakes practice



Presentations: The iSci Guide to Best Practice

Preparation

- Use props as necessary (i.e. cue cards and visuals)
- **Practice, practice practice!**
- Preparation brings up the choice between memorization and speaking extemporaneously; choose wisely according to personal preference.
- Know your content back to front, but don't memorize a script.
- Test the technology
- Have a back-up plan
- If presenting in a group, be sure that there's no overlap in content; aim for good flo good transitioning, etc.
- Stay calm
- Wear appropriate clothes
- Coherence between sentences
- Don't fidget; it's extremely distracting for people sitting in the audience
- Do not chew gum while presenting

Structure

- Introduction, main headings throughout, conclusion
- Try to have logical sequence of slides, so that the presentation flows

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Poster design

- Send students out into the campus to find posters. Get them to photograph and then come back to discuss.
- Offer guidelines on creation, formatting, etc.
- Feedback on draft version

Future Planning

- End of year symposium
- Level Three project deliverables: podcasting, web magazine, instruction
- Independent study project
- Tweaking Level One class

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In Conclusion